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Latitudinal gradients as scientific tools for psychologists

Evert Van de Vliert[1] and Paul AM Van Lange[2]

It is an unmistakable fact of life that animals and plants function differently at lower and higher latitudes with distinct temperatures and rainfall. No less unmistakable are the opposite directions of these latitudinal gradients above and below the equator. Therefore, it would be surprising if there were no opposite north–south gradients in human functioning in the northern and southern hemispheres. And indeed, recent publications and projects have started to validate, integrate, and explain such north–south gradients in cognitive ability, creativity, ingroup–outgroup dynamics, aggressiveness, life satisfaction, and individualism versus collectivism. Our brief review of these contemporary trends cumulates into a latitudinal-tools matrix for further integration and sophistication of the latitude-related ecology of habitual mindsets and practices.

Addresses
[1] Department of Social and Organizational Psychology, University of Groningen, The Netherlands
[2] Institute for Brain and Behavior Amsterdam, Department of Experimental and Applied Psychology, VU Amsterdam, The Netherlands

Corresponding author: Van de Vliert, Evert (e.van.de.vliert@rug.nl)

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Introduction

A safe prediction for the future of psychology is that the field will become increasingly global. This development concerns where psychologists are educated and work on the job, whom and what they study, and to whom and how they apply the results. Like other scientists, psychologists increasingly study samples and serve clients from all over the world—from the East to the West (longitude), and from locations that vary drastically along latitude. It is this spread and diversification that will undoubtedly give rise to an immense database of similarities and differences in psychologically relevant features of culture. That growing mountain of big data will be overwhelming, especially if there is no strong logical or even methodological framework for understanding such similarities and differences.

To fill this void, we propose latitudinal psychology as an emerging field, and introduce latitudinal gradients as metric tools that can help describe, validate, and ultimately explain variations in such psychologically relevant features as happiness, creativity, conflict, and collectivism. The term cultural features indicates that our reasoning is rooted in the assumption that habitual mindsets and practices (often called traits) operate in important ways at the level of groups, communities, and entire societies. More so than traits, cultural features reflect the idea that regularities in mindsets and practices are strongly shaped by biological, economic, and political circumstances linked to differences in geographical latitude.

A latitudinal gradient is an interval measure of how strongly a variable is related to the north–south axis of the Earth [1•]. Core gradients in humans are personality traits, values, beliefs, and behaviors with a north–south cline [1•,2•,3•,4,5•,6–8]. These core latitudinal gradients in habitual mindsets and practices derive their importance directly from human dependency on latitudinal gradients in animals [9–11] and plants [12,13], and indirectly from all living species' dependency on latitudinal gradients in temperatures and rainfall [7,14,15,16•]. Because they are ultimately set in motion by solar energy radiation [5•,6,17], all latitudinal gradients have a north–south rather than east–west distribution [1•,7,16•].

By implication, then, psychology should pay careful attention to the presence of north–south differences and the absence of east–west differences in livability and life. For centuries, biologists have been paving the road by exploring and explaining a wide variety of latitudinal clines in nonhuman animals and plants [18]. This was extended in the 1990s by the observation that human language diversity tends to be greatest near the equator and tapers off toward the north and south poles [19–21]. Only recently, psychologists have started to recognize the importance of latitudinal gradients for shaping their discipline in a fundamental fashion [1•,2•,3•,4,5•,6–8,22,23].

Latitudinal gradients as descriptive tools

Values, beliefs, and behaviors do not come into being by taking space but by taking place. Human ecological space unfolds around geographical place. As a descriptive consequence, it appears to be more accurate and clearer to observe, for instance, that collectivism decreases at higher latitudes above and below the equator [16•], than to say that collectivism flourishes where there are more microorganisms and parasites [9,10], where rice

agriculture is abundant [12,13], or where heat and poverty define daily life [24,25]. Part of the greater precision is the test–retest reliability of the latitudinal gradient of a cultural feature such as collectivism in the northern and southern hemispheres. In our view [1•], dependent variables and predictors must fulfil two criteria to fully qualify for proper use as latitudinal gradients: (a) as a sign of convergent validity, the descriptive relationship with the north–south axis should reverse its direction near the equator, and (b) as a sign of discriminant validity, the descriptive relationship with the east–west axis should be insignificant.

Latitudinal gradients as explanatory tools

More or less explicitly, several recent hypotheses, models and theories have used latitudinal gradients in animals [9–11], plants [12,13], temperatures [3•,7,8,25], and rainfall [14,15,16•] as valid means to help explain latitudinal gradients in culturally shared mindsets and practices. We discuss them in this order, that is, from more proximate to more remote causation. Amending the belief that 'the only clear predictor of a country's position on the cultural map appears to be its economic development' [26,27], wealth is discussed as a modifier of the effects of climatic stressors. But we start with latitudinal gradients in animals and plants.

The pathogen-stress theory [9–11] concentrates on latitudinal gradients in microorganisms and parasites. It successfully predicts that human-to-human transmitted diseases promote collectivism, xenophobia, ethnocentrism, and related manifestations of culture. This is because in hotter regions with higher levels of pathogen stress stronger ingroup assortative sociality helps avoid infection through fewer contacts and interactions with outsiders and strangers. Alternatively, focusing on latitudinal gradients in plants, the rice–wheat hypothesis [12,13] argues that rice communities historically had more intense and more reciprocal labor exchanges than wheat communities. To manage irrigation networks, inhabitants of rice villages had to coordinate water use and shared infrastructure—often between families and at the village level. This created a culture with interdependent ties in relatively tight networks. Thus, the distinction between tight-near ingroup ties and loose-distant outgroup ties became stronger in rice regions than in wheat regions.

Despite their many differences, the pathogen-stress and rice–wheat frameworks share the idea that collectivism and ingroup–outgroup differentiation evolved from higher tropical climate stress at lower latitudes. It is easy to underestimate the relevance of this common denominator given that the north–south axis does, whereas the east–west axis does not, represent a bipolar field of ecological stressors. Specifically, unlike different longitudes at the same latitude, different latitudes at the same longitude confront humans directly—and indirectly through feeding on animals and plants—with vastly different seasonal cycles of temperatures, rainfall, and pathogen prevalence, ultimately set in motion by solar energy radiation [1•,5•,17]. In essence, all latitude-related explanations of mindsets and practices relate to this geographical and ecological asymmetry, which should not be misleadingly interpreted as climatic determinism [4,14,25].

More so than the pathogen-stress and rice–wheat frameworks, the CLASH model about CLimate, Aggression, and Self-control in Humans [2•] explicitly emphasizes its latitudinal nature. Van Lange *et al*. [2•,4] argue that colder winters and especially larger seasonal variations in temperature at higher latitudes call for more year-round planning (e.g. winter protection, sowing, harvesting, and food storage), which increases future orientation and key aspects of self-control in the short run and, through it, decreases aggression and violence in the longer run. In agreement with the CLASH model, ingroup–outgroup hostilities, business costs of aggressive crime and violence, domestic conflict, press repression, political oppression, and legal discrimination all peak near the equator and taper off toward the north and south poles [7,8,16•]. As argued in the Extended CLASH model [4], climate may shape pathogen prevalence and wealth-related conditions (e.g. income inequality, governance, and religiosity), which are the more proximate and perhaps more determining predictors of aggression. This poses an interesting scientific puzzle.

The climato-economic theory of culture [25,28] highlights the occurrence of heat and poverty toward the equator versus cold and wealth toward the poles. Much evidence has been found for the central propositions that (a) higher thermal demands are appraised as more threatening by poorer people but as more challenging by richer people, (b) poor people's climate-related threat appraisals activate survival-oriented and prevention-oriented goals that increase tight vertical collectivism while decreasing creativity and happiness, and (c) rich people's climate-related challenge appraisals activate growth and self-expression goals that increase loose horizontal individualism as well as creativity and happiness [15,16•,17,23,29–31]. Kusano and Kemmelmeier [11] discovered a complex mediation path by showing that climato-economic theorizing also predicts socio-political freedom but that the effect disappears when controlling for the role of pathogen stress, natural disasters, and their interactions with economic wealth.

The temporal thermo-hydraulic theory of freedoms [14] combines climatic demands, animal farming, and wealth resources to account for latitudinal gradients in autonomous individual choice. This theory proposes that (a) the interplay of winter cold, summer heat, and steady rain has historically shaped dairy farming and genetically based lactose tolerance around 1500 which, over subsequent

centuries, (b) has first interacted with steady rain in shaping empowering resources around 1800, and (c) has then interacted with empowering resources in shaping encultured freedoms in 2000. In two studies covering 108 Old World countries [14], an interdisciplinary team—composed of Van de Vliert, Welzel, Shcherbak, Fischer, and Alexander—found robust support for this form of gene-culture coevolution.

The latitudinal-tools matrix

To illustrate what we can learn from this perspective, imagine a matrix with columns for the descriptive and explanatory tools, respectively, conceptually connected to as many rows as there are latitude-related frameworks about ecological imprints on human functioning (see Table 1). Imagine further that you want to add a new row to the matrix about the climatic ecology of the Big Five personality traits. Imagine finally that you choose to achieve this objective through two climate-trait studies within two large nations in order to rule out confounding effects of country-level differences in history, culture, system of governance, and wealth-based resources.

This is not a fictional case. Wei *et al.* [3•] assessed the Big Five personality traits among 5587 inhabitants of 59 Chinese cities and 1 660 638 inhabitants of 12 499 ZIP-code areas in the United States. Using a recently invented thermometer for measuring local livability [32] and advanced multi-level and machine-learning analyses, they made an intriguing discovery. Both Chinese and US inhabitants who grew up in climates with milder temperatures, and thus less cold and heat stress, score higher on agreeableness, conscientiousness, emotional stability, extraversion, and openness to experience. What on Earth is going on? The latitudinal-tools matrix can help seek sophisticated answers to this kind of nontrivial conundrum.

Notably, unlike links between temperatures and traits, latitudinal gradients do not mix up descriptions and explanations. The same latitudinal trait distribution can be related to various latitudinal gradients in animals, plants, climatic ecologies, and solar radiation. Moreover, the descriptive tools draw attention to the existence of opposite north–south gradients in traits on the other side of the equator, and the nonexistence of east–west gradients in traits along longitude. Finally, cells in the same column uncover potential for methodological or conceptual integration of north–south gradients in traits or cultural features. Eagerly waiting to be discovered is a latitudinal gradient in psychology with the breadth and grandeur of the latitudinal gradient of biodiversity in biology [18–21,33–35]. For that unknown future theory, we have reserved the last row in Table 1.

Table 1

The latitudinal-tools matrix

Conceptual framework	Latitudinal gradients as tools	
	Descriptive	Explanatory
Pathogen-stress theory of culture	X	X
Rice–wheat hypothesis of collectivism		X
Extended CLASH model of aggression	X	X
Climato-economic theory of culture	X	X
Thermo-hydraulic theory of freedoms		X
Unknown future theory		

X = Column tools and row framework have been connected in at least one publication.

Limitations and challenges

Latitudinal psychology is no magic device for theory development. The strength of highlighting the global positioning of human functioning comes with the weakness of neglecting the altitude of the place, the fertility of the soil, and the access to rivers and seas. Also, the strength of linking temperatures and rainfall to mindsets and practices comes with the weakness of ambiguity about the mediating and modifying mechanisms between habitats and habits. However, these limitations are also opportunities as part of a research agenda for the next decades. Perhaps the greatest challenge of all is breaking the dominant mantra of east–west differences in culture and replacing it with the empirically robust insight that distance to the equator has much more psychological relevance than distance to the Greenwich meridian.

There have been strong calls for psychological science to move beyond research limited to inhabitants from WEIRD Western, Educated, Industrialized, Rich, and Democratic societies [36,37]. A more promising and more challenging future direction for psychology is not from the west to the east, but from higher to lower latitudes differing in atmospheric climate and biogeographic diversity. Indeed, the seemingly divergent conceptual frameworks in Table 1 converge into the tenet that WEIRD psychology results from neglecting north–south rather than east–west differences in a rich variety of cultural features. It is becoming clearer and clearer that latitudinal gradients provide scientists with ingenious tools—for description and explanation—to understand not only the natural worlds of animals and plants but also the cultural worlds of individuals and groups targeted by psychologists, and other social and behavioral scientists.

Conflict of interest statement

Nothing declared.

References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- • of special interest

1. • Van de Vliert E, Van Lange PAM: **Latitudinal psychology: an ecological perspective on creativity, aggression, happiness, and beyond**. *Perspect Psychol Sci* [In press].

Suggests and details a new field, latitudinal psychology, that delineates differences in human functioning along northern and southern rather than eastern and western locations. Latitudinal gradients in culture are explained by latitudinal gradients in temperatures and rainfall as remote predictors, and pathogen prevalence and collective wealth as more proximate predictors.

2. • Van Lange PAM, Rinderu MI, Bushman BJ: **Aggression and violence around the world: a model of CLimate, Aggression, and Self-control in Humans (CLASH)**. *Behav Brain Sci* 2017, **40**:1-12.

Introduces and develops the general rule that aggression and violence increase as one moves closer toward the equator. Lower temperatures, and especially higher seasonal variations in temperature at higher latitudes, are thought to produce a slower life strategy, a more pronounced future orientation, and a stronger focus on self-control—important inhibitors of aggression and violence.

3. • Wei W, Lu JG, Galinsky AD, Wu H, Gosling SD, Rentfrow PJ *et al.*: **Regional ambient temperature is associated with human personality**. *Nat Hum Behav* 2017, **1**:890-895.

Reports two large-scale studies within China and the United States. The results robustly show that both Chinese and Americans who grew up in areas with milder temperatures (i.e. closer to 22°C or 72°F) score higher on personality factors related to socialization/stability (agreeableness, conscientiousness, emotional stability) and personal growth/plasticity (extraversion, openness to experience).

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5. • León FR, León AB: **Why complex cognitive ability increases with absolute latitude**. *Intelligence* 2014, **46**:291-299.

Reports analyses of 506 347 Peruvian children's reading and math scores from a national census. Robustly confirms, as predicted, that complex cognitive ability increases with latitude even under tropical megathermal climates. The findings support the speculative theory that decaying UV_B radiation, vitamin D_3 reduction, and smaller family size, in this order, improve the child's intellectual environment.

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Reports that intergroup discrimination in preindustrial and contemporary societies peaks near the equator and tapers off toward the poles, while being unrelated to longitude. This geographical observation can be accounted for by the global ecology of tropical climate stress (warm winters, hot summers, and irregular rainfall), largely mediated by the interaction of pathogen stress and agricultural subsistence.

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